Civil engineering has been around for thousands of years, even though the term is only about 200 years old. Many of the first civil engineering projects involved a precious resource: fresh water. All societies need clean water for drinking and for growing crops. But it took a civil engineer to figure out how to get it to the right place, at the right time, and in the right amount.
Fifteen hundred years ago, the Mayans of Central America built drainage ditches, reservoirs, and irrigation canals to move water to their farms. Six centuries before that, the Romans in Europe erected aqueducts to carry drinking water from mountain springs to their cities. Around the same time, Chinese engineers designed the Dujiangyan irrigation system to control floods, and it’s still working in the 21st century! Today, modern dams are supplying water for millions of people all over the world. The Three Gorges Dam on China’s Yangtze River is the largest water-control structure ever built. It’s visible from space!

Are all dams created equal? Let’s find out. **Put** damp sand in the container. **Make** a high mound, or sand dam, about 3 inches from one of the short sides of the container. **Pour** in water and fill up the “valley” on the long side (see illustration). **Time** how long the dam holds the water before it seeps through to the other side. Now **use** the building materials to **make** a dam as watertight as possible. What did you learn from watching the sand dam? Consider where you should place your dam. What’s the best shape for it? After you build your dam, test it by pouring water into the valley again. How long did it take the water to seep through? Did it work better than the sand dam did? Did it work at all, or do you have to design something better? See if you can **make** it more watertight.

Try these fun activities and start thinking like an engineer.

**Dam It Up!**

Your challenge is to build a leakproof (or almost leakproof) dam.

Down on the Levee

When Hurricane Katrina struck, 80 percent of New Orleans ended up under water when the levees (floodwalls) failed. But why did the levees fail? Civil engineer Brian Collins and a team of engineers and scientists set out to find the answer. The team used a specially designed laser to collect data and create detailed 3-D computer images (or maps) of the levee breaks and soil erosion. They discovered that many of the levees broke due to “overtopping” (when the overflow of water erodes the ground beneath a floodwall). And three of the levees broke because the ground beneath them was not strong to withstand the flow of water under the levees. The team’s discoveries will help keep New Orleans and other places safe from future flooding.

**Gelatin Jiggle**

Don’t believe it? Check out for yourself how water pressure works.

Put your hand in a plastic bag. Leave the top open, then stick it in a large bowl of water. Can you feel the plastic press on your skin? That’s water pressure, pushing hard from all directions and squeezing the air out of the bag.

**Building Materials**

- small cup of gelatin (see directions below)
- plastic food-storage container (about 12 inches long)
- watch or clock with second hand, or timer
- modeling clay
- damp sand
- pebbles
- water

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Check out some of the biggest, strongest dams in the U.S. at: www.usbr.gov/dataweb/dams/index.html

Gelatin Jiggle

Why does the Leaning Tower of Pisa lean? It’s built on unstable soil. It needs piles to help it stand. Piles are steel or concrete beams that engineers drive deep into the ground to keep tall buildings from sinking or tilting. Try the Gelatin Jiggle. No, it’s not a new dance craze. It’s a fun challenge to test how engineers try to stabilize the ground beneath structures.

Build the tallest stack of pennies you can on top of a gelatin cup (no, the flavor doesn’t matter).

Building Materials
- small cup of gelatin (see directions below)

Buy or make the gelatin. If you make it, use a small container about 2 inches high. Fill it with gelatin to the cup’s rim. Stack your pennies on top of the gelatin. How high can you go before your penny tower jiggles over?

Try it again. Start by restacking a few pennies, then push three or more toothpicks straight down into the gelatin close to and around the pennies. (The toothpicks’ lower tips should hit the bottom of the plastic container.) How high can you build your penny tower now? (Make sure to throw the used gelatin away when you’ve finished, and wash your pennies! They’ll be sticky.)

Real Pressure

Did you know that the pressure at the bottom of a lake or dam 33 feet deep is double the pressure on the surface? Don’t believe it? Check out for yourself how water pressure works.

Put your hand in a plastic bag. Leave the top open, then stick it in a large bowl of water. Can you feel the plastic press on your skin? That’s water pressure, pushing hard from all directions and squeezing the air out of the bag.

The sand and clay dams in the Dam It Up! activity didn’t experience much water pressure. But with a real dam, one that can be hundreds of feet deep, water pressure is a real engineering challenge. At 100 feet underwater, the pressure can destroy a brick wall. But civil engineers are smart and creative. They try different designs until they find one that works for a particular dam.

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Tunnel Down Under

For this challenge we'll give you a hint—think tunnel shields. Civil engineers build tunnels beneath buildings, or other structures, without toppling them by using tunnel shields. These are large metal cylinders used to line and reinforce a tunnel during construction. Once the tunnel has been completed, the protective shield can stay in place or be removed.

Make a tunnel that doesn’t collapse inside a box.

Building Materials
- cardboard box (at least 1 foot wide and 2 feet long)
- newspaper
- 2 empty paper towel rolls
- masking or shipping tape
- damp sand
- long-handled wooden spoon or other digging tool

If you are working inside, first cover the floor with newspaper. Then have an adult cut holes (about 2 inches in diameter) in opposite ends of the box. Make sure the holes are in the same place on both ends of the box. These will be your tunnel’s entrance and exit. Pile the damp sand in the box until it is at least 2 inches above the top of the holes.

Think about the best way to build the tunnel. Will you dig straight through one side of the sand or will you work from both sides? Now build your tunnel.

Check out these resources:
Built to Last: Building America’s Amazing Bridges, Dams, Tunnels, and Skyscrapers
by George Sullivan
Describes the building of some of the country's most important structures

asce.org/kids/
Fun activities and information on civil engineering

http://dfc.discovery.com/convergence/engineering/engineering.html
Take an interactive tour of the transatlantic tunnel and other extreme engineering